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ABSTRACT

A computer-assisted instructional program to teach the Arabic writing system and elementary vocabulary and comprehension, which was developed at the Center for Middle Eastern Studies at The University of Texas at Austin in cooperation with the university's College of Liberal Arts, is described. Among the benefits of the computer-assisted approach are that the active participation of the student maintains interest and alertness, quick reinforcement and feedback promotes learning correct answers and reduces the possibility of repeating the same error; and the student can follow a flexible learning pathway suited to individual capacities and needs. The following instructional design model has been developed at the computer-assisted instructional laboratory: describe the contractual agreement between staff and student; describe the order of presentation, the number of tests, the conditions for success in a test, the branching techniques, and the number of frames in each section; write a clear definition of the goals and behavioral objectives and carefully analyze the course content; describe what a learner must do to demonstrate that the objectives have been reached; specify the learning hierarchy and intermediate objectives needed to reach the terminal objectives; determine the individualizing techniques to be used; and choose the interface techniques. It is suggested that correct analysis of the content and objectives of the course forms the foundation for choosing the most appropriate display of subject matter, response techniques the student can use, and subsequent feedback by the computer. Appended materials include a description of the computer-assisted instructional program for modern standard Arabic, including sample frames, and a reprint of an article that describes the writing system ("The Computer as an Instructional Device for the Arabic Writing System," 1972, by Victorine C. Abboud). (SW)

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# COMPUTER-ASSISTED INSTRUCTION IN ARABIC AT THE UNIVERSITY OF TEXAS AT AUSTIN

## Philosophy Behind the Program

Foreign language instruction is facing a great challenge today. Many students with different backgrounds and aptitudes must learn a foreign language. However, there are not enough qualified language teachers to meet the need. In most colleges the teaching load is 20-30 students per teacher. With this ratio, even with the aid of a language laboratory, it is difficult for the teacher to provide adequate individualized instruction. Moreover, many students, intimidated by the difficulty of learning a new language, particularly a non-Western one, hesitate to commit themselves to the effort. They need new, exciting approaches to language to stimulate them to undertake the task.

Foreign language learning involves the establishment of a set of habits, both neural and muscular, that must be so well learned they function automatically. Especially in the early stage learning processes are highly dependent upon the number of teacher-student interactions that occur during instruction. In a regular 50-minute period in a class of 30 students it is uncommon to attain more than five interactions between the teacher and any one student. This is an inadequate level of interaction if we believe that foreign language acquisition is a process of habit formation strengthened by reinforcement. It is therefore of great importance that the student be given the opportunity for enough practice to achieve fluency in speech and writing.

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In conventional classroom practice, reinforcement, whether positive or negative, is rarely immediate. A teacher in a large class cannot give careful personal supervision to every student. The teacher has to make sure the entire class understands the lesson to some degree, yet he or she is unable to accommodate individual differences in speed of learning, motivation, and previous foreign language experience.

Individualized instruction would be the answer, but time and financial constraints make it impractical on a broad scale. What is urgently needed is a more efficient teaching method that can be adapted to the unique needs of individual students. To be successful, this new method must maximize each individual's performance so that he will learn rapidly, retain what he has learned, and be able to transfer the skills acquired to new situations. Such a method will achieve still greater success if it presents learning as a challenging and interesting experience.

Background on Development of the Program at The University of Texas

Over the last several years the Center for Middle Eastern Studies at The University of Texas at Austin in cooperation with the institution's College of Liberal Arts has sponsored a pioneering effort to improve the teaching of Arabic, a language of increasing importance in international affairs. The effort has resulted in two computer-assisted instruction programs: one designed to teach the Arabic writing system; the other designed to teach elementary vocabulary and comprehension. Developed by Dr. Victorine C. Abboud, Assistant Professor of Education and Director of the Computer-Assisted Instruction Laboratory of the Center for Middle Eastern Studies, these programs are the first of their kind in the United States and, to the best of our knowledge, the first in the world.

Dr. Abboud has demonstrated that a well-conceived computer-assisted instruction (CAI) program, combined with carefully coordinated classroom instruction, is a much more effective method of teaching Arabic than conventional classroom techniques or programmed instruction alone and that it better accommodates individual differences in learning.

The CAI writing program, in use at Texas since 1971, reduces the 30-36 classroom hours required by other instructional methods to four to six hours at the computer terminal and three hours of classroom time for sound drills. Despite this greatly reduced teaching time, CAI-taught students have scored significantly better on tests of writing and dictation than control students taught by conventional classroom or programmed instruction methods.

The program for elementary Arabic vocabulary is being used by students at the University of Texas for the first time this year. Preliminary results indicate that this CAI program, combined with classroom instruction, will increase the retention of vocabulary and reduce from three semesters to two the time required to complete the elementary level of Modern Standard Arabic.

The material that follows includes: (1) a description of the general technical approach used in developing these CAI programs; (2) the reprint of an article from Computers and the Humanities that describes the writing system; and (3) a description of the CAI Program For Modern Standard Arabic.

## The Technical Approach

Building upon the special capabilities of the computer to provide a direct interface with multiple users, Dr. Victorine Abboud utilizes behavioral and content analysis to design instructional software that adapts the teaching process to the needs, abilities and goals of the individual student. Her general technical approach in developing computer-assisted instruction programs is described below.

A. Computer Capabilities

1. The instructional program is stored in the computer, and the student interacts with the program via a graphics terminal that responds to his actions. The computer constantly compares the student's performance with the standards set by the teacher. When the student masters the material to be learned, new material is presented. If his performance is below the required standard, he is directed to remedial material. At the end of each lesson he is tested. If he does well (90% or better), he goes on to the next lesson; if 80% he is given his grade and is branched to review after which he is given another test; if he achieves less than 80%, he repeats the complete lesson. If he still fails, he is given remedial exercises based on his errors. This method assures that the student will assimilate the material at one level before he goes on to the next.

2. Through the computer the student receives individualized instruction. He is able to work at his own speed, repeating parts of a lesson when necessary or going ahead to the next one. The student has at least 50-60 interactions (two-way communications between computer and student) in a 50-minute session -- ten times as many as he can get in class. Since he can spend as much time as he needs at the computer, there is a very good chance that even a slow student will be able to achieve the required level of learning in a short time.

3. The computer handles a large number of students simultaneously and gives each of them an immediate response.
4. Working with the computer, the student must take an active part in the program; he cannot remain passive. He must act before he can have any response from the computer; this, in turn, stimulates his interest and encourages more intense concentration.
5. The student needs feedback as to the correctness or incorrectness of his responses. The shorter the time span between response and feedback the more efficient is the learning of the correct response and the extinction of the wrong response. The computer can provide this feedback in as little as one to five seconds. If the answer is correct, the student receives a statement of encouragement. If it is incorrect, the computer tells him why it is wrong and provides the correct answer.
6. The computer allows the student to repeat an exercise, or a lesson, as many times as he needs. It has infinite patience; even when a student asks for the same response many times, it will remain unruffled, always providing the necessary response or instruction. The shy or slow student tends to relax in this private, non-critical environment, and the learning process is enhanced.
7. The computer can be used very successfully for reinforcement, fading out the stimulus, and cueing (or prompting). Its graphics capability permits full utilization of illustrations, animation, graphs, maps, and other visual aids.

Thus, CAI enhances the principal mechanisms of learning. The active participation of the student keeps him interested and alert; quick reinforcement and feedback help him to learn correct answers and reduce the possibility of repeating the same error. Most important, the student can follow a flexible learning pathway suited to his individual capabilities and needs.

B. Instructional Design Model

The major factor in the success of CAI is the development of high quality instructional programs. The writing of such programs for foreign language instruction is a difficult, painstaking, costly, and time-consuming task. It requires a sound instructional design plus the intuition and sensitivity of an experienced foreign language author. The following instructional design model has been developed at the CAI laboratory at Texas to provide guidelines for curriculum development and to help the author in designing and writing effective programs.

1. Describe the contractual agreement between author and student. The objectives should be clearly specified at the beginning of the program, and the student should be given all the conditions that have to be fulfilled for him to obtain a good grade. The order of presentation, the number of tests, the conditions for success in a test, the branching techniques, and the number of frames in each section should be fully described.

When he understands the conditions that are required to achieve success at each step in the learning process, the student is able to choose his path, evaluate his success,

and control his progress.

2. Write a clear definition of the goals and behavorial objectives and carefully analyze the course content. The behavioral objectives must be specific.
3. Describe what a learner must do to demonstrate that he has reached the objectives. Specify conditions under which the learner is expected to achieve the objectives.
4. Specify the learning hierarchy and intermediate objectives needed to reach the terminal objectives. The intermediate objectives are obtained by an analytic process which leads to a determination of what the learner must be able to do in order to achieve success on the next higher level objective. These intermediate objectives mediate positive transfer to higher levels in the learning hierarchy.
5. Determine the individualizing techniques to be used. The different options which allow the student to take a path best suited to his capabilities must be shown by flowcharts. These options can be put either under program control or under learner control.
6. Choose the interface techniques. A wide range of display and response modes is necessary for language learning. The goals, behavioral objectives, and learning hierarchy provide the basis for selecting materials, instructional methods, and media for presentation of intermediate objectives. Correct analysis of the content and objectives of the course to be taught forms the foundation for choosing the most appropriate display of subject matter, response techniques the student can use, and subsequent feedback by the

computer. To some extent the design of the interface will dictate subject matter and learning standards, but the author must decide what is the best form of presentation to achieve optimal results for the different tasks.

In the process of developing the CAI program, the author may find that by restructuring the course content he can provide a more powerful and economical procedure that will increase efficiency in instruction and provide greater motivation for the student than can be achieved by conventional classroom instruction alone.

4/81

# The Computer as an Instructional Device for the Arabic Writing System

Computers and the Humanities, vol. 6, no. 4, March 1972, pp. 195-207

Victorine C. Abboud*

Arabic, the native language of 100 million people, is also used by many more millions as the language of the Quran and Islamic Law. The script in which it is written, adapted to Persian and Urdu, is used by about 600 million people. It is therefore next in importance to the Latin alphabet in the world today. Unfortunately, total unfamiliarity with the writing system looms as a great obstacle to an English speaker who wishes to learn the language. To decipher right-to-left passages of Arabic script seems at first glance to demand weeks of dedicated toil. Assimilating the multiplicity of graphic and phonetic facts, and finding order and meaning in their arrangement, seems to be a difficult task. Students who embark on a program of study find quickly that the pace of learning for one student is poorly matched with that of another, so that the slower students are likely to be left far behind by the pace of a conventional classroom.

There is thus a great need for a quicker, more efficient method which can be adapted in a unique way to individual learning, a method which will provide the student with a rapid interactive feedback. This, in turn, by decreasing the classroom time needed for supervised instruction, can free teachers to use the material taught in new and creative ways. Although programmed instruction is a step in this direction, it is limited in that its feedback, while immediate, is quite restricted in format; its branching capabilities are also limited and, where present at all, based mainly on multiple choice. The linear format and pacing features of audio tapes used in programmed instruction may not permit adequate individualization in pace or content coverage to account for extremes in the learning rates of different individuals.

The position taken in this paper is that a well conceived computer-assisted instruction (CAI) program in the Arabic writing system will be a more efficient and effective method than either conventional classroom teaching or programmed instruction, and will better accommodate individual differences, especially at the lower end of the ability spectrum. While the use of a computer is important, behavioral and content analysis and design are decisive in the effectiveness of any instructional program. The one described in this report demonstrates how instructional software design provided an independent restructuring of goals, objectives, and organization; yet used computer capabilities to obtain an increase in the efficiency of instruction.

*A detailed account of this program appears in the author's "A Computer-Assisted Instruction Program in the Arabic Writing System," Technical Report No. 4, February 1971, Computer-Assisted Instruction Laboratory, University of Texas at Austin, National Science Foundation Grant GJ 509 X.

*Victorine C. Abboud is a research associate in the Computer-Assisted Instruction Laboratory at the University of Texas, Austin.*

*Computers and the Humanities/Vol. 6, No. 4/March 1972*

**Instructional Design**

The CAI program in the Arabic writing system follows an instructional design model which represents a sequence of activities performed by a designer of a program and the products of each activity.[1] In this paper the following topics will be examined: (1) justification for the use of the computer in this application; (2) analysis, including objectives, the learning hierarchy and course content analysis, and flowcharts which show the main patterns of individualization; and (3) synthesis, namely interface specifications of display and response conventions, and special techniques used by the author in developing this program.

*Justification*

Although CAI may be viewed as an extension of some methods of programmed instruction, it draws on additional capabilities which can make it a far superior form of instruction. Some of these are many more options for individualizing instruction, immediate feedback, management of a complete system of events of great complexity, and the capability to control a variety of complex display and response entry devices.

There are extensive differences among students in the rate of learning various language tasks. Even within a supposedly homogeneous population, the differences in ability to attain mastery of relatively simple tasks produce many problems for the teacher and result in a wide range of performance. This problem, greater when students have to learn a foreign language, is further compounded when the writing system of that language is very different from their own. Arabic presents such a problem. Some students are quick to acquire proficiency in the art of writing Arabic script but may find difficulty in remembering the correct form of the letter in a particular word (most letters take four forms depending on their position in the word). Other students need more time in actual practice of drawing the new shapes and associating them with the right sounds. In a basic language course, efficient language teaching is greatly dependent on the number of interactions that occur during the class hour (an "interaction" is a two-way communication—teacher request, student response, teacher feedback—between teacher and student). In a regular 50-minute period it is uncommon to attain more than five or six interactions between teacher and any one student. At the computer, on the other hand, the student can easily attain 50 to 60 individualized interactions in a 50-minute session, ten times as many as he can get in class. Working at his own speed, each student is able to repeat parts of the lesson when necessary or to go ahead to the next task. Since the student can also spend time at the computer outside the classroom in his free time, there is a very good chance for even slow students to achieve the required level of learning in a relatively short time. In addition, each student must take an active part in the program. Because he must respond overtly before he can get any response from the computer, he is forced to spend more time on a particular learning task.

In conventional classroom writing practice, informative feedback is rarely immediate. A teacher teaching a class of 12 to 15 students finds it very difficult to correct the Arabic handwriting of every student for every letter or word he attempts. But a computer can simultaneously handle a large number of students and give each of them an immediate response. Within a second or so the student knows whether he is right or wrong. This speed may contribute to increased student motivation and desire to go on to learn about the Arabic language, its syntactic structures, and its rich literature.

[1] An "instructional design model" developed at the University of Texas in the Computer-Assisted Instruction Laboratory guided the design and development of the Arabic writing program. This design is described by Professor C. Victor Bunderson, Director of the CAI Laboratory.

*Analysis*

Instructional design requires not only a clear definition of goals and behavioral objectives, but also a careful analysis of the course content. A learning hierarchy forms the basis of individualization and, in flowcharts, leads to the specification of display and response conventions for each intermediate objective.

The main goal of this CAI program is to teach English-speaking adult students to write Arabic correctly in the shortest time possible, and to keep them motivated and interested in the learning of the Arabic language. Though this program was prepared especially for both the cursive and printed forms of Arabic, students are also taught to discriminate sounds and to read simple material.

The behavioral objectives that a student must achieve upon completion of this CAI program are:

(1) given letters of a word in their independent form, the student should be able to choose the correct form of the word from two varieties;
(2) given independent letters which make up a word, the student should be able to write the word, connecting the letters correctly;
(3) given pairs of minimally different words in their written form, the student should be able to choose the correct form (cursive or printed forms) of the word presented orally;
(4) the student should be able to read words using diacritics (cursive or printed forms);
(5) the student should be able to write words that are dictated to him.

The standard expected from the students for each task is to obtain 80% to 90% correct in any given test constructed to measure their success in reaching these objectives. For such success, it was necessary to construct a learning hierarchy of intermediate objectives, obtained by an analysis of what the learner should be able to do in order to achieve success on any higher level. These intermediate objectives have the function of mediating positive transfer to higher levels in the learning hierarchy. A block diagram of the learning hierarchy is given in Figure 1.

The Arabic alphabet, which is written from right to left, consists of 28 letters of two major categories: six non-connectors which always retain their shape but can be connected only to the preceding letter, and 22 connectors which can be joined on both sides but whose shapes differ depending on their context in a word (initial, medial, and final position and independent form). The writing system also uses a large number of diacritical points and slashes, employed either to differentiate consonants or to represent short vowels.

With such a multiplicity of graphemes and so much to be assimilated, this CAI program is divided into four cycles, in each of which seven letters and a few diacritics are presented to the students. The choice of the letters and the order in which they are presented is not based on graphemic or sound similarity (which is the predominant practice), but rather on the statistical distribution of the letters of the Arabic alphabet and the frequency of letters used in beginning chapters of elementary modern standard Arabic books. In each cycle the student is taken through the whole learning hierarchy with the seven letters and a few diacritics at a time. At the end of the first cycle, in less than two hours at the computer terminal, the student can form meaningful words and utterances from these seven letters with the help of the teacher in class. Every cycle reviews all the letters taught in the previous cycle or cycles, and frequent tests make sure that every intermediate objective has been attained.

Tests are of two different types—for self-evaluation and for measurement and grading. In the self-evaluation, the student is presented with a number of questions. If his answer to any question is wrong, he is told that he has given an unsatisfactory answer and is given hints suggesting the reason for the error. After a pause, the correct answer is pointed out to him. If at the end of his tests he receives a grade of 90% or more, he goes

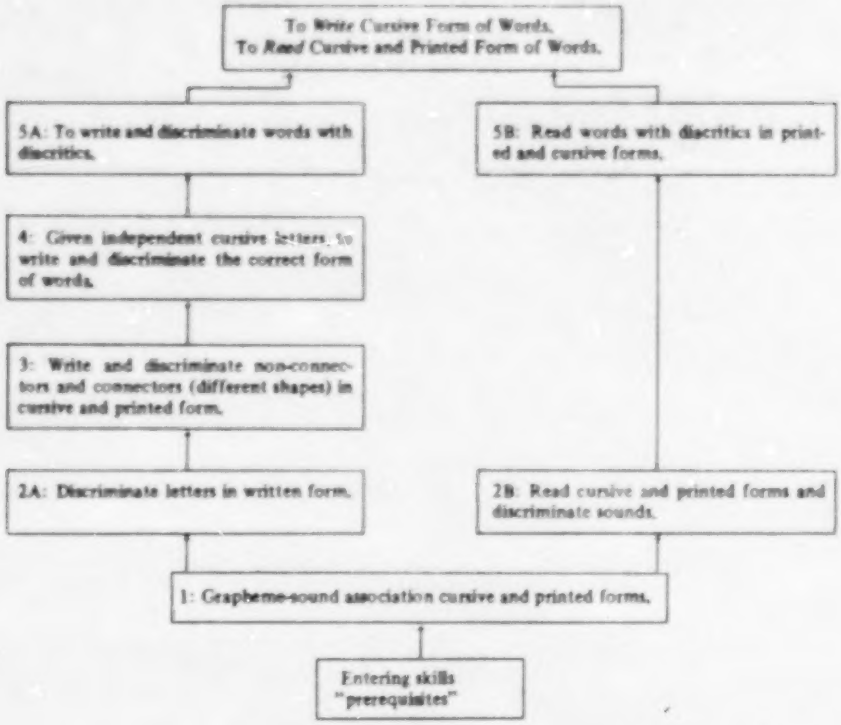

To *Write* Cursive Form of Words.
To *Read* Cursive and Printed Form of Words.
5A: To write and discriminate words with diacritics.
5B: Read words with diacritics in printed and cursive forms.
4: Given independent cursive letters, to write and discriminate the correct form of words.
3: Write and discriminate non-connectors and connectors (different shapes) in cursive and printed form.
2A: Discriminate letters in written form.
2B: Read cursive and printed forms and discriminate sounds.
1: Grapheme-sound association cursive and printed forms.
Entering skills "prerequisites"

**Figure 1. Learning Hierarchy of the Arabic Writing System.**

on to the next task, but if his grade is between 80% and 90% he is to repeat the test. If his grade is less than 80%, however, he is branched to review work, and then he must repeat the test. This self-evaluation test is followed by one for grading and measurement, in which the student is informed only whether his answer is right or wrong. If he answers 90% or more of the questions correctly, he goes on to the next lesson; but if fewer than 90% are correct, he is given his grade and asked to repeat the test. These two types of tests are given at the end of each intermediate objective in every cycle.

Flowcharts, a means of presenting information and operations so that they are easy to visualize and to follow, represent the active relationship between the intermediate objectives of the program during learning. They show the flow of data and control in an information-processing system, the operations performed in the system, and the sequence in which they are performed. The major patterns of individualizations, based on the learning hierarchy, are described in the following three flowcharts:

Flowchart 1 shows the overall mainline logic and indicates the path a student takes if successful at all points, with no request for individualization (Figure 2).

Flowchart 2 shows the logic by which the student is branched by author-specified criteria to certain points in the flowchart (Figure 3).

Flowchart 3 shows how, at the student's request, individualization can occur for the repetition of one single item or for the whole lesson (Figure 4). Provision has also been made for the student to repeat any complete cycle.

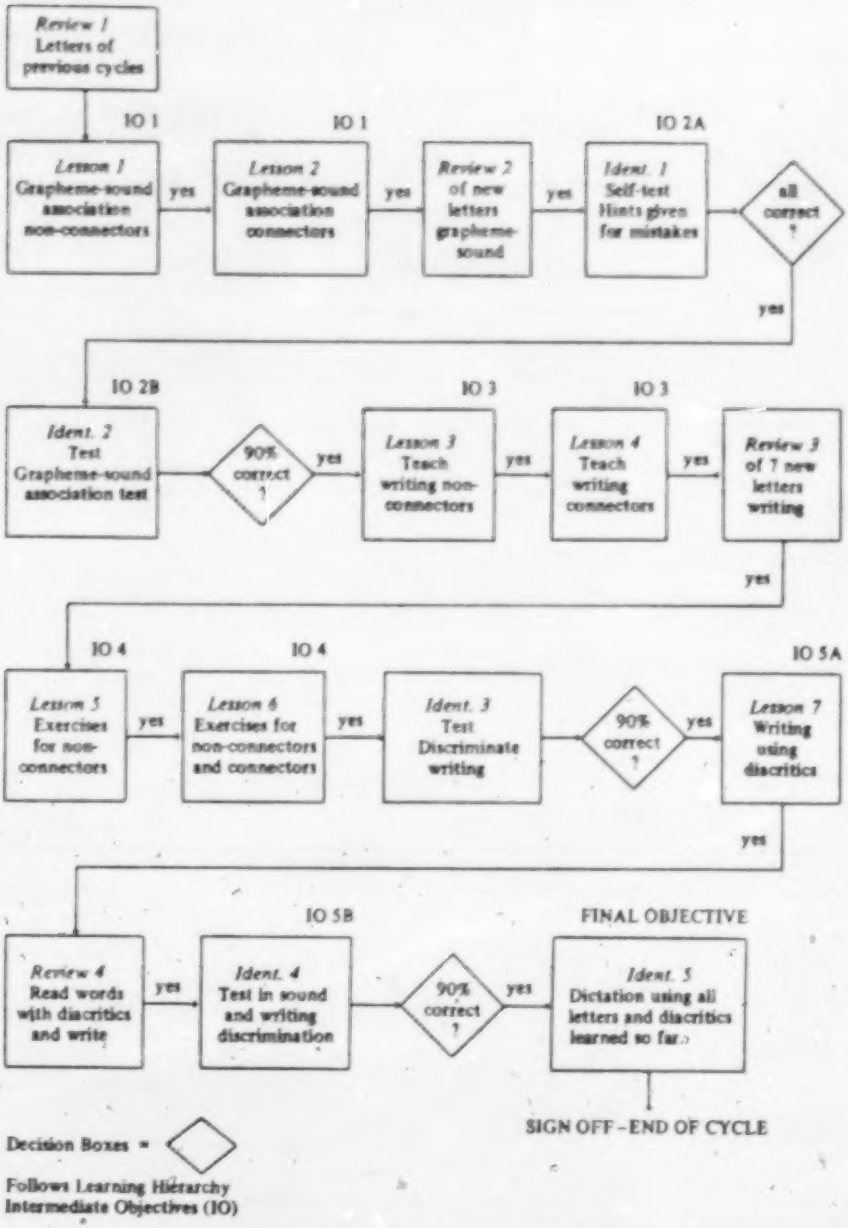



**Figure 2. General Flowchart of One Cycle when Student Follows Main Course (with no individualization or branching)**

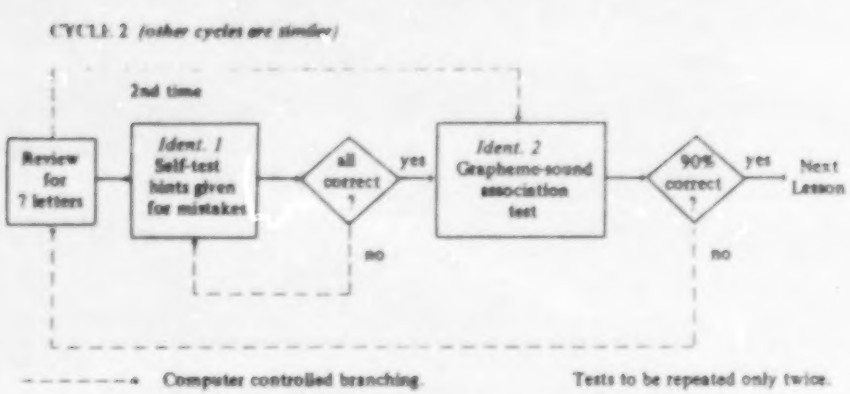



**Figure 3. Branching Capabilities under Certain Specifications Given by Author**

*Synthesis*

With the objectives and learning hierarchy of this program defined, and with the measurements of its success described, the next step was the careful study of the terminal devices available to help the student achieve such objectives. A wide range of display and response modes, according to requirements inferred from each intermediate objective, is needed for language learning. These computer terminal devices and their interface capabilities can make a unique contribution to the attainment of these objectives. Subject-matter properties and requirements for learning can be dictated by the design of the terminal devices, but the creative author must decide how to construct an effective representation from the raw display capabilities. In doing so, he must try to overcome any constraints which the system seems to impose.

With the IBM 1500 Instructional System, with its point graphics cathode ray tube (CRT), image projector (IP), typewriter keyboard, light pen, and random access audio

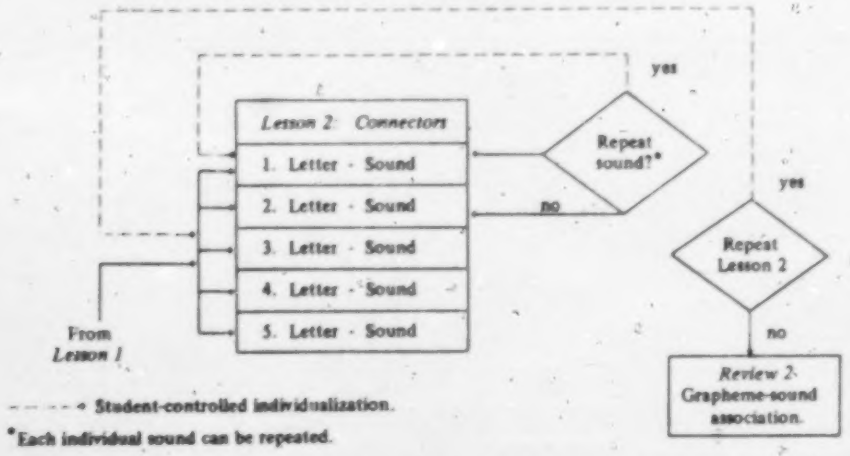



**Figure 4. Individualization under Student Control (this can occur in *every* lesson)**

unit, an instructor can develop a course that teaches the student to write Arabic and helps him, to a considerable extent, to read it as well. Coursewriter II is a computer language which allows the coders to specify the instructions needed to direct all input, output, and processing operations of the computer in controlling the various devices. This equipment permits the instructor to analyze and design an appropriate display of the subject matter the type of responses by which the student works with the subject matter, and the feedback display which will provide appropriate conditions of learning for each of the intermediate objectives in the learning hierarchy (see Fig. 1) and the program as a whole. In this program the CRT is used for the display of the graphics representing letters or words in their cursive form, the IP for the printed form of the letters and words, and the audio tape unit for the relay of messages, sounds of letters and words. The response devices are the keyboard, to enter responses in English; the light pen, to register the student's choice of answer; a grease pencil, to write on the face of the CRT; the student's vocal responses; and a notebook.

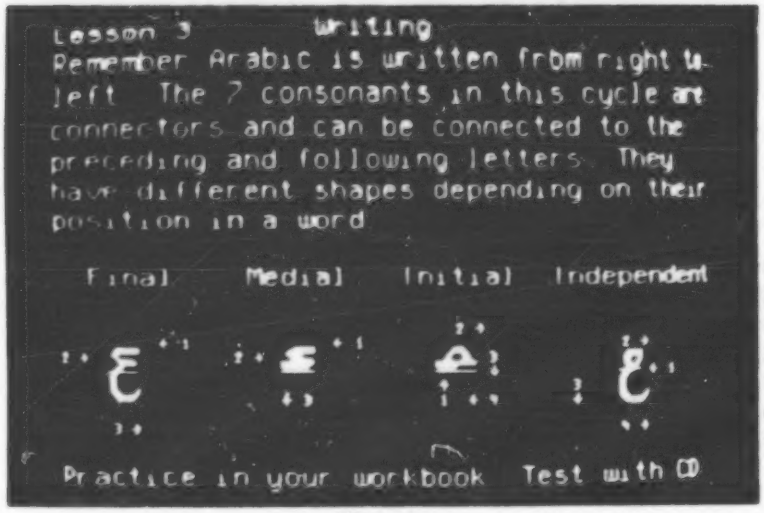
**Interface Specifications for the Intermediate Objectives**

*Objective 1: Associate graphemes with sounds.* The student is first introduced to the differences between the cursive and printed forms of Arabic script. He is also told that Arabic is written from right to left, and is then introduced to the two kinds of letters, connectors and non-connectors. In the next lesson, which introduces the new letters to be learned in that cycle, the student has an Arabic letter displayed on the CRT. While he hears the corresponding sound, it is also given in an Arabic word and is repeated. During a brief interval the student is asked to mimic the sound. After that the sound is heard for a third time.

*Objective 2: Discriminate and read cursive and printed forms of sounds.* When the seven letters have been taught, a review of all seven is displayed on the CRT. At the same time, the student is shown the printed form of these letters on the IP. Both remain displayed at the same time so that the student can learn to make associations between the cursive and printed forms. He is then asked to read all the letters. When he is ready, he can press the space bar and hear all the sounds of the displayed letters played from audio. At the end of the lesson two tests are given. In the first, which contains an average of 10 to 15 questions, the student is given an Arabic letter displayed on the CRT, and is asked to type the equivalent English letter. If he is correct, he is given some form of encouraging statement; if he is wrong, he is told his answer is incorrect. After a pause, the correct answer is then provided. The next test, for grading, gives the student a number of questions, in each of which three Arabic letters are displayed on the CRT. As a sound is repeated twice on tape, the student pushes his light pen on the letter which he thinks corresponds. If he chooses correctly, he is given confirmation, but if he is wrong he is corrected.

*Objective 3: Discriminate and write various forms of letters.* This task, the most important in this program, requires much instruction and practice. The students are now shown how a non-connector can be connected to the letter which precedes it, but not to the letter which follows it. For connectors, which can be joined to both the letters which precede or follow them, a full description is given of how their shapes differ in initial, medial, final, and independent forms. To ensure that the students learn to write correctly, guide lines are given at the beginning and then withdrawn gradually. The letter is displayed with a line to show its position, arrows point in the direction in which the hand moves, and numbers indicate the order in which the different parts of the letter are formed.

The student is given immediate feedback by a procedure which allows him to correct his own work. After the letter has been displayed with lines, arrows, and numbers, he is asked to practice it in his notebook. When he is ready, he can press the space bar;


Lesson 3 Writing
Remember Arabic is written from right to left The 7 consonants in this cycle are connectors and can be connected to the preceding and following letters They have different shapes depending on their position in a word
Final
Medial
Initial
Independent
Practice in your workbook Test with CD

Note: The letters have recently been redesigned to adapt them to the Tektronix 4025 terminal. In addition, we have achieved a routine by which the letters appear dynamically (in slow motion), making the use of arrows unnecessary.

**Figure 5a**

the letter will disappear and a white square with a black line (the size of the letter) will appear on the CRT. He can then write the letter with a grease pen on the face of the screen; pressing the space bar causes the letter to reappear on the screen through or behind his letter. He can thus compare his letter with the correct form (this procedure will be abbreviated by CD, 'Compare Display'). This is the first time such a procedure has been used in a CAI program, and it will also be used in practicing and correcting words formed of many letters (Figs. 5a, 5b, and 5c). The same letters or words will also be displayed on the IP. Colors are used on the IP to emphasize the different letters and their different forms for the first few exercises in each cycle, but are withdrawn later in the cycle.

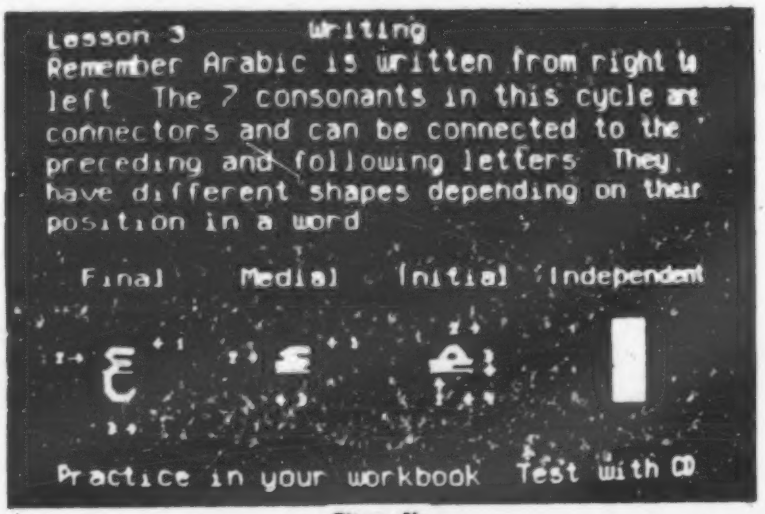

Lesson 3 Writing
Remember Arabic is written from right to left The 7 consonants in this cycle are connectors and can be connected to the preceding and following letters They have different shapes depending on their position in a word
Final
Medial
Initial
Independent
Practice in your workbook Test with CD

**Figure 5b**

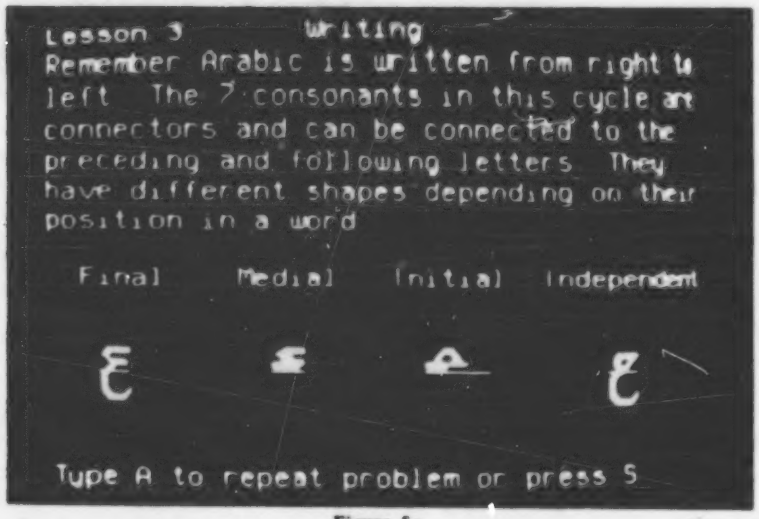

Lesson 3 Writing
Remember Arabic is written from right to left The 7 consonants in this cycle are connectors and can be connected to the preceding and following letters They have different shapes depending on their position in a word
Final
Medial
Initial
Independent
Type A to repeat problem or press S

**Figure 5c**

*Objective 4: Given independent forms of cursive letters, write and discriminate correct forms of words.* In the many exercises and drills which give each letter in all its forms and show the use of the various forms, the student is able to correct his own work. Three or four letters in their independent forms are displayed on the CRT. After the student has tried to join them correctly in his notebook, he can press the space bar to get the correct form. Using the CD technique for further comparison and correction, he can have immediate feedback. When each frame is completed on the CRT, the printed forms of the letters and words are displayed on the IP also.

As in the procedure for learning to discriminate the various forms of letters, here also a self-evaluation test is given. As three or four letters and three words are displayed, the student is asked to push his light pen on the correct form of letter. If he is correct, he gets a confirmation, but if not, a hint is given as to why his answer is wrong, and after a pause he is shown the right answer. The next test, although similar to the previous one, is given for the purpose of grading; the student is told here only whether he is right or wrong and is given a grade.

*Objective 5: Write and discriminate words in cursive and printed forms and read with diacritics.* Diacritics (auxiliary signs) which can represent various modifications in the Arabic writing system—short vowels, lengthening of consonants, no vowel, etc.—are introduced in each cycle. The student is first introduced to short and long vowel contrasts by hearing words on tape and seeing them displayed on the CRT. After more diacritics have been introduced in the following cycles, he is given words with diacritics and is asked to read both the cursive and printed forms of the words. When ready, he can request to hear them read from audio tape, and use them in writing drills.

In the next test, the student hears a word read on tape and then chooses the right form of the word from two or three words displayed on the CRT. The last test is a dictation of a certain number of words, which the student writes in his notebook. When finished, he can press the space bar and see the whole dictation displayed on the CRT and IP. At the end of each cycle, the student is shown a list of all the four cycles and is given the opportunity to repeat any cycle he needs by pushing his light pen on his choice. When all the four cycles are finished, he should be able to meet all the behavioral objectives

required. He should be able to write words dictated to him on tape and to read the cursive and printed forms of simple words using diacritics.

**Techniques**

As there was no previous work done on any CAI program for Arabic, many problems had to be solved. For example, every letter with all its forms had to be carefully drawn on IBM Instructional System Graphic Coding forms. As there are 28 letters in the Arabic alphabet, 22 of which have three or four shapes, a great number of separate graphics would have been needed. This was not possible, however, as only 64 graphics could be programmed in any one Coursewriter course. Compounding this problem was the fact that any given letter could require more than one graphic. This number was reduced by identifying similar parts of different letters; a number of dots, dashes, and inverted V's were then drawn and superimposed on the same shape. In Figs. 6 and 7, the letters *9ayn* and *Haa'* use the same lower adjacent parts (007 and 008) but their tops are different; using the same lower part for both letters reduced a number of graphics.

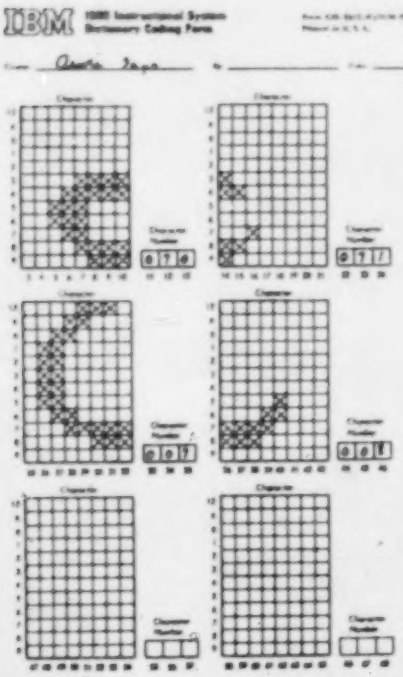


**Figure 6**

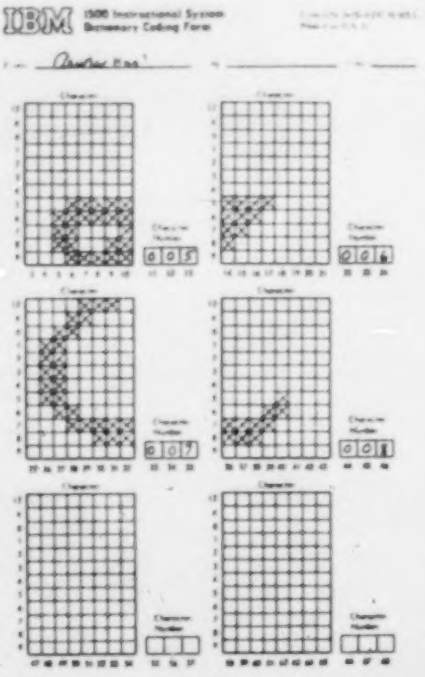


**Figure 7**

Another problem that had to be solved was that though all Arabic letters are drawn on or through the line, some of the forms of these letters start above the line, and special conventions dictate whether the letters are to be raised or lowered when joined together. A method had to be found, therefore, to draw such graphics so as to raise or lower them by half a character size and thereby eliminate the necessity for more graphics (see Figs. 8a, b, and c). In Fig. 8b, the letters are joined correctly. Fig. 8c shows that if the letter is not raised, the letters will not join correctly.

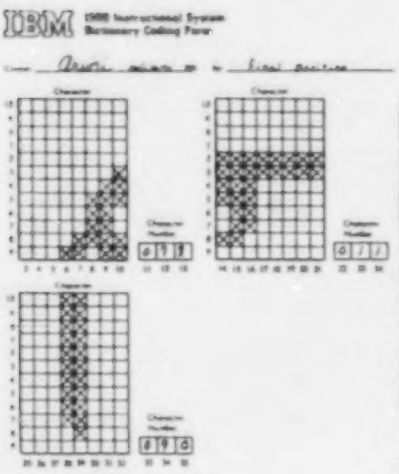


Figure 8a

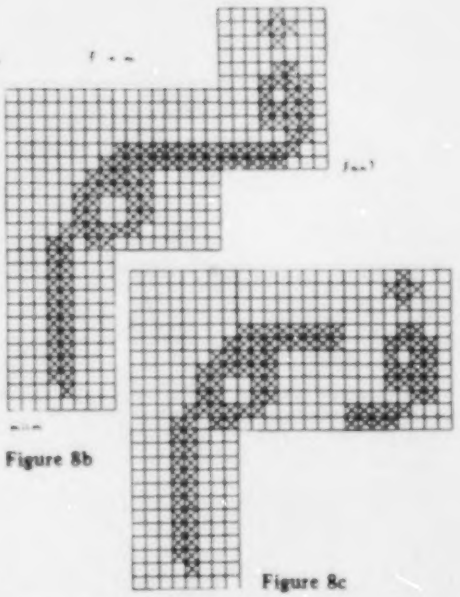


Figure 8b



Figure 8c

Two sizes of letters are used on the CRT. In tests where reading or discrimination of forms or sounds was required, regular characters, 12 dots high and 8 dots wide (Fig. 9), were used. When, however, instructions were given for practice in writing the letters, a large size of the letters was required, 36 dots high and 16 dots wide (Figs. 10 and 11). As Arabic is written from right to left, very exact coding was required. One of the important results of this effort is the development of graphics, dictionary characters, and overlay techniques for the Arabic script, which may now be standardized for a wide variety of computer applications in Arabic, and also provide a model for other programs to teach non-Latin scripts.

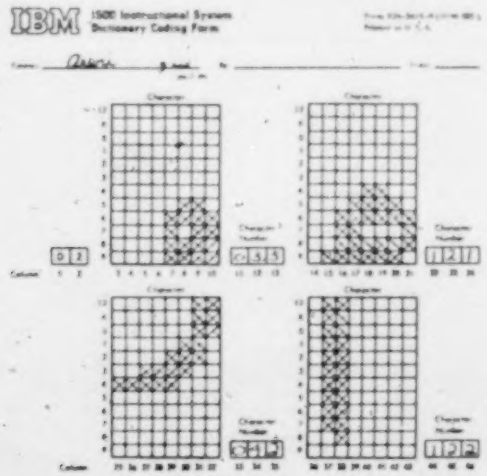


Figure 9

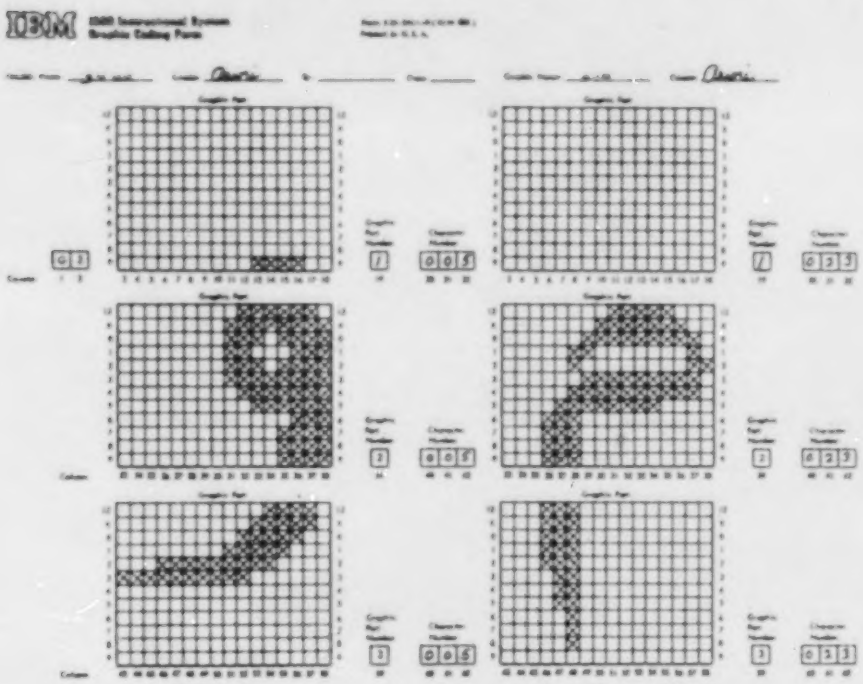


Figure 10



Figure 11

**Evaluation**

The principal result of an experiment in the teaching of the Arabic writing and sound system was the compilation of baseline data to measure the performance of the program in reaching its design goals. At the same time, baseline data was also obtained at two other universities for instruction in the same objectives, but using two different, non-CAI methods. Although it was not possible to control entry abilities of students at the three universities, nor to assure strict compatibility among procedures for teaching and testing because the three instructional procedures differed in many respects, nevertheless, the same tests were given at each university, as agreed upon in advance by the three professors. Reasonably reliable estimates of completion times were therefore available. The magnitude of some of the differences between methods, reported below, makes it less plausible to assume that uncontrolled differences in the student samples or in the teachers were responsible for the differences than that the CAI program did achieve its design goals. That is, the instructional strategies and administrative procedure of the CAI program have distinct advantages over other methods in reducing the amount of time taken to complete the course, in improving the ability of the students in the various skills, and in keeping the students interested in their work, thus reducing attrition.

Three groups of students of first-year Modern Standard Arabic participated in this experiment in 1970-71. One group of 21 students at the University of Michigan was taught through a programmed instruction course (PI). The second group of 19 at Georgetown University was taught by the audio-lingual method and in a conventional language laboratory (AL). The third group of 32 completed the course through the CAI program in conjunction with classroom instruction at the University of Texas at Austin (CAI). The time taken to complete instruction in the writing and sound system by each

of the three groups varied markedly: (1) the PI group needed 22-30 hours of instruction in the laboratory; (2) the AL group completed the course in 14 hours of classroom instruction and 12-16 hours in the laboratory–a total of 26-30 hours; and (3) the CAI group required only 4-8 hours at the computer terminals and 4 hours of classroom instruction. Thus, the CAI group used only 40% of the time taken by the other groups.

The final test for the Arabic writing and sound system, prepared with specifications approved by the three professors who taught the different groups, included writing skills, dictation, and discrimination of sounds and their association with printed forms. The results were the following: *For writing skills* the CAI group had a much higher mean than the other two groups (91.5 compared to 79.3 for PI and 68.2 for AL). The standard deviation of the CAI group was also much smaller, indicating that most of the students received scores close to the mean. Thus, learning gains were larger for the slower students, and the lower part of the class was able to catch up to the level of the students at the top. The minimum score for the CAI group was 70%; 20% for the PI group; and 15% for the AL. *For the sound and discrimination grades*, the means for the CAI group were about the same as the non-CAI groups. This was a bonus since this program was prepared especially for the writing system, although sounds were introduced.

The main contributions of this program for the teaching of Arabic are the reduction in time from six weeks (22-30 hours) to one to two weeks (8-12 hours), and the significantly superior performance in the writing ability of the students, especially those of lower aptitude. Upon completion of the CAI program at the University of Texas, the students were given an evaluation questionnaire. The tabulations of the results show that the students enjoyed the program and felt that it speeded up learning, that it was interesting, that it responded to individual needs, and that it was helpful. There was no attrition in this group. These results can be viewed as evidence that language instruction, especially in its initial stages, can be more appealing, interesting, and enjoyable. Contrary to the opinion that anything associated with computers must by definition be sterile, rigid, or inhumane, tastefully designed CAI can be a most profitable and useful tool for the serious student and can keep him interested and involved.

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# A CAI PROGRAM FOR ELEMENTARY MODERN STANDARD ARABIC

## Goals

The goals of this program are to:

- Expand, reinforce, and help the student in the retention of Arabic vocabulary items
- Increase the ability of the student to rapidly comprehend passages of written material
- Enable the student to complete Elementary Modern Standard Arabic in two rather than three semesters, while at the same time increasing the ability to manipulate vocabulary.

## Description

The program covers three semesters of work and consists of 45 lessons, each requiring about 1 to 1-1/2 hours at the computer terminal. Each lesson consists of:

- Basic texts
- A list of new words
- Vocabulary associations (by topic)
- Exercises of many types
- A test

## Basic Texts

Lessons 1 - 9 -- In these lessons vocabulary items are introduced (in context) through Arabic sentences. The English equivalents of each new word (which is fully voweled) are introduced through a flashing technique under the corresponding Arabic word. After all the English equivalents have been displayed, the Arabic sentence is erased and the full English sentence is displayed. The student attempts to translate it (in a notebook). The Arabic and English sentences are then displayed and the student can immediately check his work.

Lessons 10 - 45 -- In these lessons passages are displayed with the same flashing technique (English only appears under the new Arabic words, which are fully voweled). The full passage is not translated into English. Several exercises are distributed throughout the Basic Text to insure student activity.

## List of New Words

Following the Basic Texts new words are given. Their English equivalents appear one at a time.

Vocabulary Associations

Words grouped together around a central concept are listed under a title that expresses their relationship. No English translation is given.

Exercises

At this point the student is given a specified number of exercises chosen at random from a "pool" stored in the computer. These exercises vary in kind, and include:

- Filling in the blank
- Matching (Arabic with English)
- Matching (English with Arabic)
- Sentence generation
- Question/answer

Upon completion of the specified number of exercises, the student is presented with numerous options and, at this point, has complete freedom in the choice of his pathway. He can:

- Request additional exercises (even specify kind and number)
- Examine records of his past performance
- Request the dictionary (explained below)
- Or continue, and be tested

If the student requests the dictionary option, he will be chained to a special module. Here, the student can choose to examine words he has encountered in past units. These words can be summoned alphabetically by their roots. They appear: (1) in Arabic, with their English equivalent or (2) in English, with their Arabic equivalent together with the part of speech, irregular gender, and plural formations. The dictionary option is available throughout the program except in tests. The student can access all words that have the same root by a single command.

The Unit Test

The final module in each unit is the test. As with the exercises, the test will be composed of questions (as described earlier) drawn at random. Upon completion of the test, the computer will branch the student, depending on his performance:

- To the following unit
- Back for remedial work in the same unit
- Back to take the test again

Other Features

There are several other features incorporated into the vocabulary program which should be mentioned.

A monitor program has been created to:

- Keep track of each student's performance on tests and exercises
- Keep track of each student's location so he/she can return to the last position should he/she sign off before completing the unit
- Keep track of recurring problems with specific vocabulary items

The monitor is also capable of recording the time spent by each student on each module, as well as response time (for later statistical analysis), and can offer the student advice based on his previous performance. (For example, "I suggest you try a few more sentence construction exercises..., etc.")

In addition, a graphics package has been developed which permits on-line creation and storage of innumerable graphics (e.g., maps, special characters, objects, etc.). The use of cleverly drawn graphics will greatly increase the instructional strength of the Arabic vocabulary program, and decrease dependence upon English words as vocabulary equivalents.

If performance is satisfactory each student is allowed to play vocabulary games with the computer (e.g., hangman, crosswords, etc.). These are chosen to further motivate the student in vocabulary acquisition.

A method has now been devised for students to type in Arabic. Since the computer keyboard is not sufficient to display all the different shapes of the Arabic alphabet, an algorithm has been developed by which the computer can join letters in their correct form when only their independent form is entered on the keyboard.

This program does not duplicate but is used in conjunction with classroom instruction. Original passages and exercises are given using the same vocabulary items and grammatical structure as those introduced in the classroom textbook: Elementary Modern Standard Arabic by Peter Abboud, et al., Ann Arbor, Michigan.

The following are sample frames of the CAI programs for the Arabic Writing System and the Vocabulary and Comprehension Program for Elementary Modern Standard Arabic. A hard copier has been used to obtain these samples.

(SAMPLE FRAME)

THE ARABIC WRITING SYSTEM

# برنامج تعليم الكتابة العربيّة

AUTHOR: DR. VICTORINE ABBOUD

PROGRAMMER: STEPHEN FLORA

COPYRIGHT 1979

PRESS RETURN TO CONTINUE

(SAMPLE FRAME)

ARABIC WRITING PROGRAM
CYCLE 1
INTRODUCTION

FRAME 1 OF 1

THE MAJOR GOAL OF THIS PROGRAM IS TO TEACH YOU HOW TO WRITE THE LETTERS IN THE ARABIC ALPHABET, AND RECOGNIZE THEIR CORRESPONDING ENGLISH EQUIVALENT SOUNDS WHEN AVAILABLE.

SINCE THE MAIN EMPHASIS IN ON WRITING, HOWEVER, THE CURSIVE FORM (HANDWRITTEN) WILL BE DISPLAYED THROUGHOUT. THE PRINTED FORMS WILL ONLY BE GIVEN FOR THOSE FORMS WHICH HAVE A MARKED DIFFERENCE IN SHAPE.

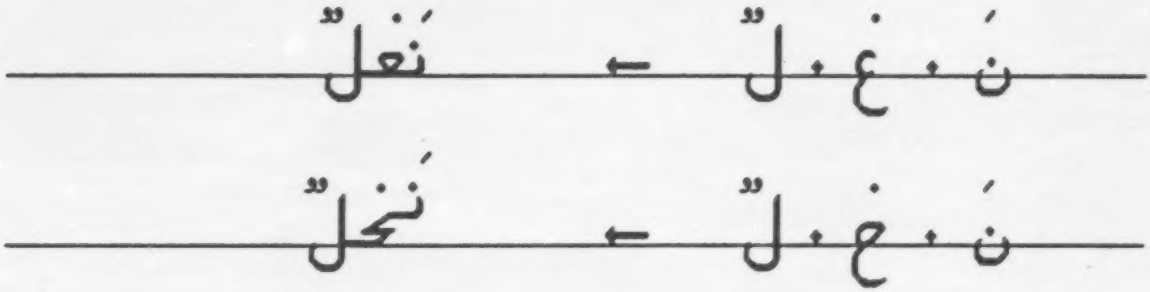
WHEN READY PRESS THE CONTINUE KEY OR
PRESS THE REPEAT KEY TO VIEW THE LESSON AGAIN

(SAMPLE FRAME)

**ARABIC WRITING PROGRAM**
**CYCLE 4**
**EXAMPLES**

FRAME 2 OF 3

THESE EXERCISES WILL SHOW THE CONTRAST BETWEEN THE INITIAL, MEDIAL AND FINAL FORMS.



WHEN READY PRESS THE CONTINUE KEY

(SAMPLE FRAME)

VOCABULARY AND COMPREHENSION PROGRAM

ELEMENTARY MODERN STANDARD ARABIC

برنامج المفردات و فهم النصوص

للعربيّة المعاصرة المرحلة الإبتدائيّة

DESIGNER AND AUTHOR: DR. VICTORINE ABBOUD

COPYRIGHT 1979

PUSH [redacted] TO BEGIN

?_

(SAMPLE FRAME)

HELLO STEVE, GLAD TO SEE YOU AGAIN

1 BASIC TEXT
2 QUESTIONS
3 BASIC TEXT
4 QUESTIONS
5 BASIC TEXT
6 QUESTIONS
7 LIST OF NEW WORDS
8 ASSOCIATIONS
9 FILL IN THE BLANK
10 SENTENCE GENERATION
11 MATCHING
12 *** START OF TEST ***
13 FILL IN THE BLANK
14 SENTENCE GENERATION
15 MATCHING
16 *** END OF TEST ***
17 END OF CYCLE

TODAY YOU WILL START WITH LESSON 16,17, SECTION 1
PRESS [redacted]

(SAMPLE FRAME)

ARABIC VOCABULARY PROGRAM B
BASIC TEXT 01

LESSON 16,17
FRAME 1 OF 10

PRESS THE CONTINUE KEY FOR EACH NEW WORD.

يذهب السيّد عادل حسين إلى مدرسة في

الساعة الثامنة والنصف صباحاً. يدرّس عادل في

مدرسة ابْتدائيّة، وهو لا يدرّس موضوعاً واحداً
SUBJECT
ELEMENTARY

فقط، بل يدرّس معظم المَواضيع. من تلك
SUBJECTS
AMONG; ONE OF

المَواضيع مَوْضوع بعنوان:
A SUBJECT SUBJECTS

Note: In every text one word is flashed in English. When the student presses the return key it disappears and the next one appears.

For purposes of economy, the English words appear together in this sample frame. However, the student would never see all the words on one frame.